

**A Device and Method for Realizing Dynamic  
Adjustment of Data Bandwidth in a Transmission Device**

**CROSS-REFERENCE TO RELATED APPLICATIONS**

5 This application is a national stage application of International Application No. PCT/CN2003/001032, filed December 2, 2003, which claims priority to Chinese Patent Application No. 03139945.2, filed July 21, 2003, both applications of which are hereby incorporated by reference in their entirety into the present application.

**FIELD OF THE INVENTION**

10 The present invention relates to Ethernet communication technology, and more particularly to a device and method for realizing dynamic adjustment of data bandwidth in a transmission device.

**BACKGROUND OF THE INVENTION**

15 Pulse Code Modulation (PCM), as a traditional concept, means multiplexing voice service to E1/T1 by PCM. With its development, particularly for demand for data services, the PCM device is enhanced in its capability to support service. Now the concept of PCM is limited to multiplexing voice, but can handle multiple services such as voice, data, image, etc. to E1/T1 on the basis of time slot, as shown in Figure 1. At the beginning, multiplexing of  
20 data and image services is realized through a V.35 interface, and the device only simply maps the V.35 channel to a time slot of E1/ T1. It generally needs an outside protocol converter or Router for realizing the data service application with the V.35 interface. Nowadays, for more conveniently and simply realizing access of data services for users, PCM equipment can supply a 10M Ethernet interface to realize seamless access of user data.

25 PCM devices have been widely used in telecommunication and special networks, such as electric power, water conservancy and public security, because of its simple technology, flexible application and reasonable price. However, in networking applications with limited bandwidth, especially special networks, it is generally required to sufficiently utilize the trunk bandwidth because rental trunk bandwidth is limited. Particularly, when voice and data access  
30 are mixed, it is required that data services can occupy idle time slots while voice is not

activated. However, service bandwidth is generally configured in a static state for a PCM device, and the bandwidth of data service is distributed to fixed time slots. Even if voice service is free, data service cannot occupy the idle bandwidth. If software is used to reconfigure the number of time slots for data service by detecting idle time slots, it will result in butting problems with opposing equipment and error codes in data services, and even service interruption caused by changing bandwidth.

### SUMMARY OF THE INVENTION

An object of the present invention is to provide a device, which can realize a dynamic adjustment of bandwidth in transmission equipment, in order to dynamically adjust Ethernet data bandwidth and effectively use repeater bandwidth resources.

Another object of the present invention is to provide a method for realizing dynamic adjustment of data bandwidth to dynamically adjust Ethernet data bandwidth and effectively use trunk bandwidth resources, especially, to realize dynamic bandwidth adjustment for Ethernet data in the intelligent integration of a PCM device in a communication domain while ensuring voice services.

The method for realizing dynamic adjustment of Ethernet bandwidth in a PCM device according to the present invention comprises adding a control channel on a PCM trunk link to describe the time slot occupancy condition of the current services (voice, Ethernet data, etc.). Application in peer networking is required for realizing this method in order to realize correct demultiplexing and multiplexing for different services.

The difference between the present invention and a traditional PCM voice and data system is to offer a channel distribution mechanism. The mechanism, under the control of a CPU, completes dynamic distribution of time slots on a PCM line. It mainly comprises circuit configurations for control word retrieving and insertion, time slot distribution and CPU interface.

Time slot distribution is controlled by channel control words written in a control channel, and the control channel may comprise one or more time slots; however, one time slot is recommended to save occupancy of the control channel in trunk data bandwidth.

Particularly, the present invention provides a method for realizing dynamic adjustment of data bandwidth in transmission equipment, in which a control channel is added in a trunk link in the transmission equipment to describe the time slot occupancy condition.

5 The control channel completes time slot dynamic distribution for the PCM line under the control of the CPU.

The time slot dynamic distribution is controlled by channel control words written in the control channel, and the control channel may comprise one or more time slots.

The current services include voice service, and Ethernet data service.

10 The method is applied in peer networking to realize correct demultiplexing and multiplexing of the different services.

The present invention also provides a device for realizing dynamic adjustment of data bandwidth in transmission equipment, which comprises: a control word process circuit, a time slot distribution circuit and a CPU interface circuit, wherein the control word process circuit is designed to complete extraction and insertion of control information in control channel of  
15 E1/T1 link; the time slot distribution circuit completes separating voice time slots from Ethernet data time slots, and rebuilding data; the CPU interface circuit is for implementing control of the time slot distribution.

The device also includes High Level Data Link Control ( HDLC ) / Media Access Control ( MAC ) frame process circuit to implement processing an HDLC link for Ethernet  
20 data, checking integrity of the MAC frame, and comparing and learning MAC addresses.

The time slot dynamic distribution circuit is controlled by the channel control words written in the control channel, and the control channel may comprise one or multiple time slots.

25 The present invention also provides a method for realizing dynamic adjustment of data bandwidth in transmission equipment, characterized in that, when a current service is multiplexed in a direction of the E1/T1 link, CPU informs the time slot distribution circuit of the time slot numbers to be occupied by the voice service according to a voice call condition, and the time slot distribution circuit releases the time slots from the Ethernet data service, and distributes them to the voice service; after the voice call is finished, the CPU informs the time

slot distribution circuit that the time slots have been released by the voice service, and time slot distribution circuit assigns the time slots to the Ethernet data service, thereby dynamic adjustment of the Ethernet data service can be implemented.

The application of the present invention, compared with the prior art, can implement dynamic adjustment of the Ethernet data bandwidth while ensuring the voice services, and it reaches sufficient and effective usage of the E1/T1 trunk bandwidth without error codes and interruption of data service during bandwidth adjustment, so that a user's data service bandwidth is enhanced.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic graph of integrated services multiplexed to an E1/T1 line;

FIG. 2 shows bit definitions of a control channel; and

FIG. 3 is a hardware schematic diagram of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

In accordance with attached figures, embodiments of the technical solutions will be further described in details as follows:

A hardware portion (FIG. 3) of the present invention comprises a control word process circuit, a time slot distribution circuit, a High Level Data Link Control (HDLC)/ Media Access Control (MAC) frame process circuit and a CPU interface circuit. The control word process circuit implements extraction and insertion of control information in the control channel of an E1/T1 link, and the time slot distribution circuit implements separating voice time slots from Ethernet data time slots and rebuilding Ethernet data, and the HDLC/MAC frame process circuit implements processing the HDLC link for Ethernet data, checking integrity of the MAC frame, and comparing and learning MAC addresses. The CPU interface circuit implements time slot distribution control. Since circuit schematic diagrams in the present invention are known to those skilled in the art, they will not be further described here.

A control channel is defined to be located in time slot 1 (FIG. 1) of E1/T1 link ( time slot

0 is used as frame synchronization of the link).

Bit definition of the control channel is shown as FIG. 2.

A Time slot segment number, which takes values 0 to 5, represents occupancy information of the 30 time slots with a time slot bit table with 5 bits.

- 5 The Time slot bit table represents the data occupation condition of a time slot (2-30) with the time slot segment number. "1" expresses that the time slot is occupied by Ethernet data, "0" expresses that the time slot is occupied by the voice service.

According to above definitions, in each E1 frame (125 $\mu$ s), it needs to express the condition of 30 time slots, but, in each E1 frame, time slot 1 can only express 8-bit information, so that it needs multiple E1 frames to express the entire time slots. A control word is made up of 3-bit time slot segment numbers and 5-bit time slot bit tables. 30 time slots are distributed in 6 time slot segments, and each time slot segment can describe the occupancy information of 5 time slots. To describe the service distribution condition of 30 time slots demands 6 frames (6 $\times$ 125 $\mu$ s = 1.5ms), and serial numbers of the 6 frames are represented as the time slot segment numbers. Table 4 lists the time slot numbers expressed by control words in 6 frames.

	Time slot bit table					Time slot segment number		
Frame 1	TS2	TS3	TS4	TS5	TS6	0	0	1
Frame 2	TS7	TS8	TS9	TS10	TS11	0	1	0
Frame 3	TS12	TS13	TS14	TS15	TS16	0	1	1
Frame 4	TS17	TS18	TS19	TS20	TS21	1	0	0
Frame 5	TS22	TS23	TS24	TS25	TS26	1	0	1
Frame 6	TS27	TS28	TS29	TS30	TS31	1	1	0

Table 4 Control word configuration

- In the present invention, the work quantity of software is smaller. In E1/T1 link, in the direction of service demultiplexing, the demultiplexing service is completely implemented by hardware without participation of software. When the service is multiplexed in the direction

of E1/T1 link (called the direction of demultiplexing), the CPU informs the time slot distribution circuit of the time slot numbers to be occupied by the voice service according to a voice call condition, and the time slot distribution circuit releases the time slots from Ethernet data at the latest 6 frames (1.5 ms) later, and assigns them to the voice service; after the voice  
5 call finishes, CPU informs the time slot distribution circuit that the circuit time slots have been released by the voice service, and the time slot distribution circuit assigns the time slots to the Ethernet data service at the latest 6 frames (1.5 ms) later, so as to realize a dynamic adjustment of the bandwidth of the Ethernet data service.